CAPARDUS - Capacity-building in Arctic standardization development

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Authors: Nathan Kettle, Olivia Lee, Noor Johnson

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EXECUTIVE SUMMARY

This report summarizes the information from interviews and a supplementary document analysis on community-based monitoring programs in Alaska that are related to the coastal hazards of coastal erosion and permafrost thaw and harmful algal blooms. The report includes an assessment of the interviews and document analysis to identify: (1) the types of community-based monitoring (CBM) information used to plan for and respond to coastal risks and hazards; (2) how existing knowledge and data from CBM programs are situated in relation to other types of information used in risk and hazard mitigation; and (3) the role of standardization in connecting community observations with decision processes. The approach aimed to develop a concept map to understand how CBM programs produce and share information. We also include some discussion on the benefits and drawbacks of greater standardization for different actors.

Table of Contents

1. Introduction

1.1 Overview of CAPARDUS Project

CAPARDUS is a Coordination and Support Action with the goal to explore ongoing processes of developing standards in selected topics of importance in the Arctic. The project will develop a Comprehensive Framework Model for development of standards, guidelines, and practices related to observing systems and data sharing in the Arctic. Furthermore, the project aims to design an Arctic Practice System (APS), which will be a repository of documents (or other communication media) that is searchable on titles, keywords, and content. The APS will be a tool for co-production of knowledge between scientists, Indigenous and local communities, and stakeholder groups involved in the case studies of the project. Project activities are focused on natural resource management, safety, community planning, decision making, and tourism. The project will include information on regional case studies primarily in Greenland, Svalbard, Alaska, and Yakutia in Russia.

1.2 Alaska Case Study Goals

Our project seeks to identify: (1) the types of community-based monitoring (CBM) information used to plan for and respond to coastal risks and hazards; (2) how existing knowledge and data from community-based monitoring programs are situated in relation to other types of information used in risk and hazard mitigation; and (3) the role of standardization in connecting community observations with decision processes. The approach aimed to develop a concept map to understand how identified CBM programs produce and share information. We also include some discussion on the benefits and drawbacks of greater standardization for different actors. Below we report on the findings from our document analysis and interviews with individuals involved in CBM Programs for coastal hazards monitoring. There were some changes in the project schedule due to the COVID-19 pandemic, which affected the ability to hold in-person activities and meet with community members.

2. Document Analysis

A web-based search was used to (1) identify community-based monitoring (CBM) programs in Alaska related to permafrost thaw, coastal erosion, and harmful algal blooms (HABs); (2) inform the development of a series of semi-structured interviews, and (3) identify potential interviewees. Search terms for permafrost thaw and coastal erosion-related CBM programs included combinations of the following words: permafrost, Alaska, community-based monitoring, erosion, networks, and local observations. The search was conducted in April and May of 2021 and identified 20 documents, websites, and reports (Appendix A). Search terms for HABs-related CBM programs included combinations of the following words: harmful algal bloom, community-based monitoring, Alaska, and local observations. This process identified 23 documents, websites, and reports (Appendix B). All documents were reviewed and coded based on the following themes: capacity building, CBM programs, information ecosystem, information needs/gaps, key individuals to interview, key partners, how Indigenous and local knowledge was involved in the observing program, standardization, and use of CBM in decision making. These findings are summarized below.

2.1. Permafrost thaw and coastal erosion CBM programs.

The document analysis identified four key CBM programs related to coastal hazards (The Alaska Native Tribal Health Consortium's Local Environmental Observatory; Arctic Alaska Observatory & Knowledge Hub; Indigenous Sentinels Network; and state of Alaska, Division of Geological and Geophysical Survey, Coastal Hazards Program). Two additional programs supporting CBM included the Landscape Conservation Cooperatives and Alaska Institute for Justice. Monitoring programs, such as university-based monitoring research projects that were short-term in duration, were excluded from the review. The CBM programs included communities across Alaska, although some CBM programs were more regionally focused (e.g. AOOKH focus in Northern Alaska). Unlike our analysis on the HABs programs we did not find an equivalent of a coordinated network of CBM programs for coastal erosion that spanned across Alaska and that facilitated a way for members to meet on a regular basis. Given the lack of a more formal network of CBM programs with named partnerships, we were unable to quantify the number of tribal communities and individuals involved in coastal hazard CBMs.

2.1.1. Information Ecosystem.

Some coordination among CBM programs for permafrost thaw and coastal erosion was identified in the document analysis. For example, the Landscape Conservation Cooperatives assisted the Indigenous Sentinels Network to expand their program throughout Alaska and Western Canada, which can complement and support ongoing monitoring efforts. Another document suggested that CBM done in partnership with federal and state government agencies is likely to be more effective, as this enables communities to access the resources and technical resources that they need to make well informed adaptation decisions (AIJ 2017). This document further suggested that "Government agencies are also able to provide communities environmental information on a regional and national level, giving them a fuller picture of the changes taking place." Bringing together both Indigenous knowledge and science was viewed as important for the adaptation planning process – a finding consistent with other literature on climate response and planning efforts.

2.1.2. Standardization.

Seven of the 20 documents referenced standardization. Several documents discussed the importance of standardizing the methods used to observe and document coastal erosion and permafrost. There appear to be several motivations or intentions behind the desire for standardization. First, some motivations center on the importance of developing actions to "better define the data to be collected, associated standardized collection protocols, and a system to connect local data collection with research institutions" in order to better integrate Indigenous knowledge as well as increase communication with researchers and agencies (Adapt Alaska 2017). In other words, using standardized protocols for CBM gives communities the data they need to document changes. Standardizing local observations and community data also enables the comparability across data from different sources. Second, standardization was viewed as important for creating a unified system for data collection and sharing information from local observer networks (Pletnikoff et al. 2017). Third, ensuring the security and integrity of data, such as not publishing subsistence resource data was also viewed as a benefit of standardization.

There were some challenges with standardization. As stated by a participant from the western Alaska workshop "There is value in standardizing, but it needs to be flexible to the specific questions asked by groups launching the effort. It's hard to standardize first until you know the questions that are of interest locally" (Pletnikoff et al. 2017, p. 36). Additionally, it was recognized that although standardized protocols could be helpful, that might not be practical given the rapidly changing conditions, and it might be better to get observations started, rather than waiting for the perfect data collection approach (Adapt Alaska).

Some efforts intended to build capacity to develop standardized monitoring efforts. These often focused on standardized data collection protocols and data management, such as a guidebook developed by the Alaska Division of Geological & Geophysical Surveys (DGGS), University of Alaska Fairbanks (UAF), Bristol Bay Native Association, and Alaska Sea Grant (Buzzard et al. 2019).

2.1.3. Information Needs and Linkages to Decision-making.

Specific information needs from CBM were not frequently identified in the document analysis. However, several documents expressed a need for CBM, including: (1) the need to initiate a CBM system within their climate adaptation plan; (2) the need for local baseline data for risk assessments (ANTHC, ETC); (3) developing a plan for permafrost monitoring locally to track change over time; (4) creating a unified system for coordinating data collection and sharing; and (5) developing a more complete picture of change in communities. Other needs included building capacity for community-based monitoring (AIJ 2017). Documents also mentioned that better coordination was needed among agencies and between agencies and communities. Clarifying procedures for working with federal and state agencies was viewed as important for enhanced coordination. "Participants also urged state and federal agency departments to work together as a team and coordinate on climate change resilience efforts, with the goal of creating a network with fewer points of contact that could make it easier for small communities to work with them" (Pletnikoff et al. 2017).

2.2 Harmful Algal Blooms (HABs) CBM programs.

The document analysis identified multiple organizations and agencies involved in CBM of harmful algal blooms across coastal Alaska. Some programs represented partnerships across multiple tribal organizations and governments. For example, the Southeast Alaska Tribal Ocean Research (SEATOR) lab represents a network of 16 tribal governments that partner and pool resources to monitor HABs in over 52 sites weekly. Additionally, several other organizations in regional hub communities have recently developed or are developing lab facilities for HABs, such as the Chugach Regional Resource Commission (CRRC) that in 2021 represented seven tribal governments to monitor shellfish beds. Other CBM programs in Alaska include, but are not limited to, Kachemak National Research Reserve, Kodiak Native Association, Aleut Community of St. Paul, Qawalangin Tribe of Unalaska, Aleutian Pribilof Islands Association, Norton Sound Health Corporation, Agdaagux Tribe of King Cove, and Knik Tribe of Alaska. The Alaska Harmful Algal Bloom (AHAB) Network plays a central role in providing a mechanism to support ongoing communication and collaboration as well as facilitating data consolidation and synthesis of local, regional, and statewide data into resources and products. The AHAB network consists of over 100 individuals from over 30 institutions and organizations.

These HABs CBM programs emerged from strong cultural traditions and connections to shellfish, their importance for food security, a high level of risk to paralytic shellfish poisoning

(PSP), limited access to medical care, and no statewide program to monitor recreational and subsistence harvest of shellfish. As such, several tribes desired a better understanding of baseline conditions, sought answers for why there were increases in PSP, and desired actions that could be taken to reduce risks. At the same time, these CBM programs face several challenges in the collection, analysis, and dissemination of HABs information. First, the wide variety of environments with low population densities along with the harsh environment complicates the use of high-tech sampling methods (e.g., imaging flow cytobots). At the same time, Tribal members have intimate knowledge of Alaska's coastline and are well positioned to take measurements. Second, there is often not a local laboratory for testing, so samples are often sent to Anchorage or other regional hubs for testing. However, rural communities face significant challenges in transporting samples to urban centers for testing in a timely and cost-effective manner, especially due to limited and often weather-dependent air service.

2.2.1. Information Ecosystem.

Assessment of data from the document analysis revealed several ways that HABs information is intended to be used. Some documents described generally how HABs data were intended to provide general information about toxicity to the tribes, including regulatory data. For example, the toxin levels exceeding the Food and Drug Administration's regulatory limit as detected from the SEATOR network trigger public serve announcements, including on local media stations (Anderson et al. 2019). Other documents described how HABs data were used in management plans (n=3), such as how tribes can use information to make shellfish harvest recommendations. Additional potential uses of information discussed included using HABs data to understand local and regional vulnerabilities and informing decision making. Specific examples of the use of HABs information in planning documents was not identified. However, two documents noted that adaptation strategies required an understanding of where and when HABs are likely to occur; one discussed how information on HABs can support the development of adaptation strategies by enabling harvesters to make more informed management decisions (Fraley 2019); the other emphasized the importance of understanding changes in when and where HABS are likely to occur in a warmer climate (NOAA 2022).

HABs data are recorded on several websites and databases. Databases identified in the document analysis included local and regional databases provided by SEATOR and national-level databases such as Sound Toxins (soundtoxins.org) and the Phytoplankton Monitoring Network. The AHAB network makes data from the SEATOR database publicly available.

2.2.2. Standardization.

Four of the 20 documents referenced "standardization" or "standards" directly related to HABs. These documents discussed the need to collect data with regulatory standard analysis (Trainor et al. 2014; NPRB 2020), the need to secure funding to develop a technical standard operating procedure manual (SEATT 2015), and the need to develop a standard sampling protocol tailored to each region (AHAB 2021a). The AHAB monitoring networks priority to ensure standardization across the multiple regions of the state emphasized the need to recognize the unique needs and logistical constraints for each region. Several additional documents discussed elements of standardization, though not using the term standards or standardization. For example, proven CBM techniques for HABs developed by the NOAA National Centers for Coastal Ocean Science (NCCOS) and the Phytoplankton Monitoring Network were often applied and adopted in other regions (NCCOS 2020).

2.2.3. Information Needs and Linkages to Decision-making.

Specific information needs from CBM were not frequently identified in the document analysis. General information needs included: (1) an understanding of where and when HABs are likely to occur in the future, (2) why the changes are occurring, where the changes are occurring, and how many people are getting sick; and (3) linkages and the transfer of toxins within food webs. In addition to information needs, several documents discussed training events for HABs monitoring. This included in-person and remote trainings for the following topics: (1) use of NCCOS citizen science methodologies and techniques for HABs monitoring; (2) learning to use phytoplankton nets, filtering apparatus, and identification tools; (3) toxic phytoplankton sampling and identification; and (4) detailed instruction on microscopy, toxin screening methods, and online data entry. These trainings were considered critical in building local and regional capacity to enable Alaska communities and participants to begin collecting baseline data, increasing the area being monitored, and integrating information into a larger Alaska HABs monitoring network (AHAB 202b; Maucher and Morton 2022).

3. Interview Findings

Interviews were conducted with 13 individuals (81% response rate) involved in CBM programs related to harmful algal blooms (HABs) and coastal erosion in Alaska. These was some overlap in CBM data collection for some programs, which made it challenging to categorize the number of interviews into the specific hazard observing category. HABs and coastal erosion CBM included monitoring programs supported by Tribes, the state of Alaska, consulting groups, and University of Alaska Fairbanks. Interviewees were identified by a web-based search and snowball sample. Findings are divided into three sections: CBM monitoring data, collection, and management; use of CBM data; and collaboration.

3.1 Community-based monitoring data, collection, and management

CBM data and observations are collected to monitor extreme events and long-term change. These data include western science, local knowledge, and Indigenous knowledge. CBM data relevant to coastal hazards include erosion, storm surge, snow and sea ice thickness, whaling trails and travel conditions, ocean conditions (temperature, salinity, productivity), extreme weather, wildlife, sea ice mass balance, river ice conditions, and coastal mapping data (topography, bathymetry, orthophoto imagery, water level data). Data for HABs include phytoplankton identification, toxicity, water temperature, and other environmental data (e.g., temperature, tide, weather, etc. during sampling period). These data and observations include photographic data, narrative observations, videos, and data from scientific instruments.

Motivations for collecting and gathering CBM data related to coastal erosion and HABs in Alaska were linked to several factors. Responding to community-articulated needs, interests, and requests was the most frequently identified motivating factor (n=8). In the case of HABs, communities were especially interested in gathering data to support food security, food safety, and first foods (n=5). First foods broadly refer to the wide variety of species that Indigenous Peoples continue to rely on for providing cultural, physical, and spiritual health. Collecting baseline data and archiving long-term change (n=6) were considered important for planning and decision making. Other motivations for collecting these data included understanding connections between environment and health, supporting regional comparisons, providing HABs monitoring and testing not provided by the state of Alaska, enabling data sharing, providing observations previously demonstrated as useful, detecting local- to statewide change, and understanding scientific processes.

In addition to responding to community-defined needs, CBM program staff took several steps to increase the relevance of the data gathered. Collaborative approaches with communities and other agencies and organizations were the most frequently identified step to increase relevance (n=5). Collaborations ensured that the data collected was approved and discussed with the community, helped identify community needs, and allowed community members to determine how and when data was shared, and with whom. Customizing observation protocols, including adapting the species lists that are monitored and how data are collected based on local capacities and constraints, were also frequently used steps to increase relevance. As stated by program staff for a HABs monitoring program,

> The technician told me that they cooked them [badarki, a member of the mollusk family] in the round. I always thought you'd just cut the foot out right and eat just the foot, which is probably always non-toxic anyways…so I learned a few years ago to cook the whole thing. They are easy to clean. Then you pull it out of the shells and then sent the whole body in for testing. So here again, the local peoples are behind the project design (Interview 07).

Other steps used to ensure relevance and meet needs included providing trainings for local observers. This was considered important to ensure relevance and meet needs (n=3), and to develop relationships to further assist in understanding needs and connect communities that are monitoring for coastal hazards and HABs.

CBM of coastal hazards and HABs are collected in multiple ways. Some classifications of how observations are collected include: standardized vs. non-standardized observations; scientific instruments vs. personal observations; paid observers vs. volunteers; and manual vs. automated observations. Several specific procedures for collecting CBM data were also identified (Table 1), each method often reflecting the specific capacities and constraints of the region. In several cases, communities send their data to other agencies and organizations for processing, as they do not have the internal capacity and resources for these analyses.

Table 1: Some data collection methods for CBM in Alaska.

Coastal erosion and hazards
Community members take photos, if safe during a storm
Regular observations of ice and weather conditions and explanations of sea ice features
Install a flood staff and survey staff when flooding happens, if safe
Time lapse cameras and having a stake in the ground to measure the coastline
Surveying with auto levels and stadia rods
Harmful Algal Blooms
Tow/pull a phytoplankton net from a deck or dock, look at it under a microscope. Sample sent to a lab
Manually collect a sample of water and run through a qPCR test. This lets you see the gene sequence of the organism you looking for and how much of it is there
Set up a hanging basket of blue muscles that hangs off the dock, and then sample on a weekly basis
Collect mussels at low tide
Sample from the nearshore

How programs selected data collection protocols were influenced by several factors. Local contexts and capacities were the most frequently identified factor influencing data collection protocols (n=6). These contexts and capacities included internet availability, staffing levels and experience, geography (e.g., on and off-road communities), and infrastructure. Feedback from communities also influenced data collection (n=5), such as where to sample, how to sample, and what to sample. Feedback was obtained via talking circles, steering committees, and ongoing conversations. As stated by a CBM program manager:

> There's been a lot of thought and time put into sort of these kinds of questions [on data collection protocols]. **How to make it respectful, how do you make it safe? How do you make everyone feel like they're being equally and fairly represented…? How to make sure that the kind of information we're gathering is not misconstrued** as being hard science and not misconstrued as being traditional knowledge, but being kind of a gathering place for information from both areas of knowledge. (Interview 01)

Other factors influencing data collection protocols included simplicity of use (n=5), aligning with testing criteria (n=2), proven effectiveness (n=2), availability of funds (n=1), available trainings (n=1), legacies of data collection (n=1), timeliness (n=1), and accuracy (n=1).

Obtaining and sustaining funding were the most frequently identified challenges in data collection for CBM programs (n=4), including funding to pay observers and analyze samples. Other programs mentioned the challenges associated with internet bandwidth and availability (n=3). Maintaining and sustaining community-based monitors and technicians is a challenge for some (n=3), but not all programs. These challenges included turnover in observers, limited availability of samplers due to other commitments, and recruitment of new observers. Other challenges included the logistics and timeliness of shipping HAB samples that effects how quickly toxicity levels are communicated, level of interest given other ongoing challenges (e.g., COVID, extreme weather events), and data sovereignty. One CBM program manager detailed the multiple challenges associated with Quality Assurance Project Plans, including staff time, expertise, and funding to work through documents: “It's a long process and an uphill trying to figure out staff capacity and funding and all the parts and pieces of it…the whole system is set up poorly to let Tribes participate” (Interview 09).

Multiple organizations informed data collection approaches for HABs monitoring. For example, one HABs monitoring program adapted their protocols from the state of Washington, as these protocols were designed to provide sampling for commercial, subsistence, and tribal entities. Both Alutiiq Pride Marine Institute (APMI) and KANA also collaborated with and adapted their monitoring efforts from SEATOR in part due to the success of SEATOR in rural Alaska. Collaborations between APMI and KANA were also perceived as effective in learning what worked across different regions in Alaska. Other CBM programs follow data collection procedures outlined by the state of Alaska Department of Environmental Conservation (DEC), and had DEC perform the toxicity testing. The Alaska HABs Network was viewed as an important venue for sharing the tradeoffs of different data collection approaches across different contexts in Alaska. NOAA’s phytoplankton monitoring network system for water samples was another approach adopted by several programs. Other data collection approaches from coastal-hazard CBM programs were informed by regional tribal health organizations, tribal staff funded by the General Assistance Program (GAP), coastal engineers from the University of Alaska, and other working groups (e.g., Alaska Water Level Watch).

Alaska CBM programs used several tools and systems to collect and manage data, including databases and portals, websites, and apps. Tools to collect data included write-in-the rain notebooks, mobile apps, websites and online forms, and e-mailed or mailed observations and data. Databases and web portals are often used to manage the collected data. Some data are reported to national-level databases, such as SoundToxins. Other data are reported to regional Alaska databases, such as the SEATOR's database or HABs databases managed through the Alaska Ocean Observing System. In several instances, programs changed the tools and systems used to collect and manage data in response to keeping up with technological change over time and to respond to community needs. For example, SEATOR is revamping and improving the data platform where tribes can enter and export their data on phytoplankton to increase accessibility and use of data in agency reporting.

3.2. Use of community-based monitoring observations

CBM programs aimed to provide information to several groups, including Tribes and local governments, state and federal agencies, scientists, co-management organizations, and the public. Tribal or city governments, corporations or consortia, and subsistence hunters were the most frequently identified user group (n=7). These data were intended to be used for informing hazard mitigation and climate adaptation planning, helping new managers become familiar with the environmental issues of concern in the area, food safety and security, and to provide deliverables for tribal environmental and emergency managers. Data were also provided to state and federal agencies (n=3), such as shoreline erosion assessments that can be used to help make policy or budgetary decisions, toxicity data that is inputted into national-level databases, or shellfish toxicity data to assist in making recommendations to the public. Two programs provided information to co-management organizations and agencies. Managers for CBM programs identified several ways in which their observations were used in specific products, including hazard mitigation plans, climate adaptation plans, Alaska-wide annual ecosystem status reports, General Assistance Program (GAP) workplans, documents to help justify reimbursement for disaster declarations, and baseline assessment reports (Figure 1). Interviewees also identified several challenges to making these data more usable, including need for quicker turnaround and helping communities interpret CBM data, limited internet and complicated data portal interfaces, and the need for more sampling (e.g., more locations, greater frequency).

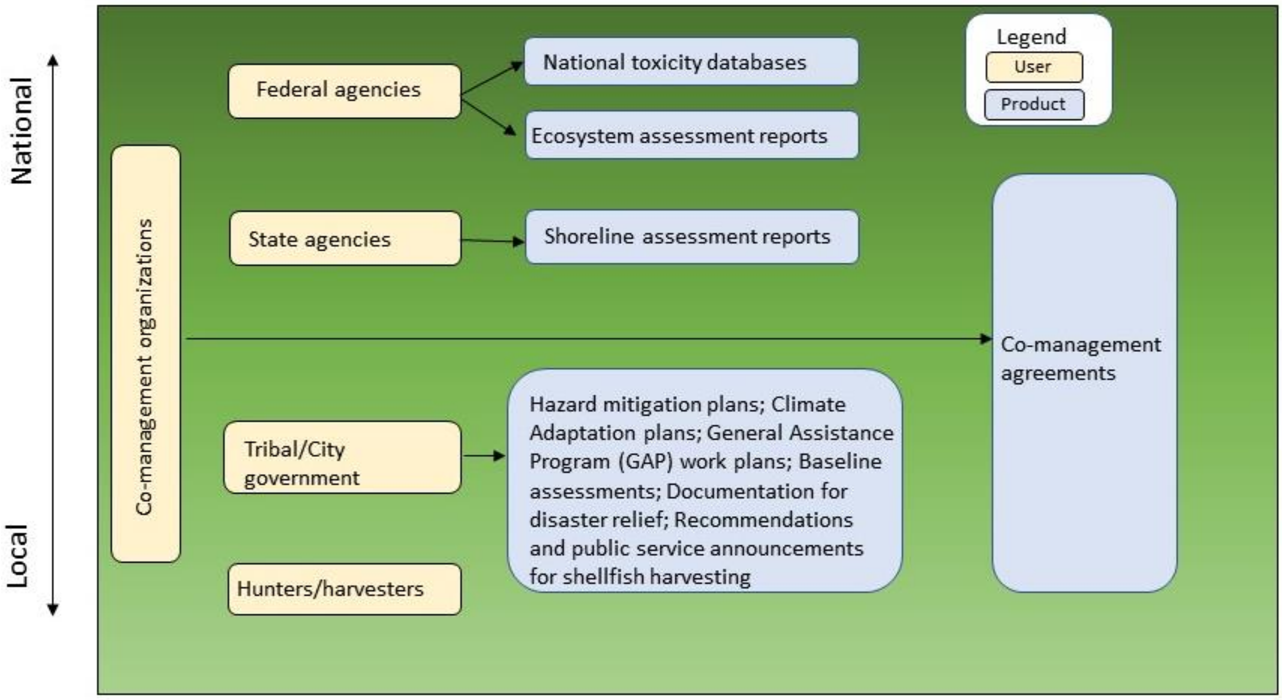

Figure 1. Users of data from coastal hazard CBM programs in Alaska and the products that were identified with these users, based on information shared during interviews for this case study. It also shows the decision scale associated with each user, ranging from individual hunters and harvesters at the local scale to federal agencies at the national scale. Co-management organizations span multiple scales of use. This figure will be refined based on feedback from participants in focus groups during the next phase of this case study project.

3.3. Collaboration

Interviewees (n=12, 92%) identified several ways that CBM programs collaborated. Some CBM programs shared or adapted data collection protocols to standardize procedures and leverage proven and established methods for data collection and analysis across Alaska. Other programs discussed the importance of consulting other CBM programs about data collection activities, protocols, and standardization. Consultation was especially important for new CBM programs. For example, several CBM programs discussed the value of consulting with other HABs monitoring programs to have conversations about gaps in protocols, how samples are taken and shipped, and how to overcome emergent challenges. Other forms of collaboration between CBM programs included data sharing, storage, and aggregation, supporting graduate student research, joint proposal writing, assistance with start-up (funding and equipment), lab analysis and testing, and training and support. Identified challenges to collaboration included the difficulty in finding a one-size-fits-all approach or protocol for the diverse contexts and monitoring needs, understanding the mechanisms needed to support collaborations, a lack of funding and staff capacity to support collaboration, difficulty knowing what other programs are doing, and internet access.

The Alaska HABs Network (managed by the Alaska Ocean Observing System) was viewed as especially important by several interviewees in supporting collaboration among CBM programs. Key roles played by the Alaska HABs Network included supporting a centralized venue for networking, sharing, and learning, as well as providing support for uploading data to statewide and national databases and providing data storage. Other interviewees discussed the importance of Alaska Sea Grant Marine Advisory Program Agents in supporting their monitoring efforts, given their experience, knowledge, and connections in the area. Several participants also worked with the Alaska DEC Environmental Health Lab to support testing toxicity of tissue samples. There does not appear to be a central coordinating organization for coastal erosion and permafrost monitoring networks, though there is notable collaboration. Other networking functions of collaborations included helping agencies and organizations interface with communities, training children at schools on sampling and analysis, sharing data collection and analysis protocols with other CBM organizations, sharing effective practices and methodologies, providing training on phytoplankton identification using microscopy, and developing quality assurance plans.

Overall, interviewees expressed a high level of interest in supporting a platform to exchange methodologies, guidelines, and effective practices relevant to CBM. Specifically, interviewees viewed this platform as important in breaking down silos and making sure information and tools were shared, connecting communities and exchange protocols, exchanging study designs, and increasing capacities to network with communities.

Several participants discussed how the Alaska HABs network already serves several of these functions. At the same time, interviewees identified several concerns or considerations, such as dedicated funding for a coordinator to support the exchange platform, other competing obligations and commitments, the scalability of observations, and resources needed for updating effective practices. Specific capacities desired for this platform included a spatial component to know where the methodologies were being applied and a message board where questions could be answered. Identified concerns about almost universally centered on data ownership and sovereignty (n=6). Individuals were especially concerned about the difficulty of maintaining sovereignty once data are pushed onto other platforms. The interview questions did not include further questions to get recommendations for overcoming challenges related to data sovereignty concern.

Other throughs and comments related to collecting and sharing observations from CBM program leads included:

> There are several ways you can monitor for HABs, but all the ones that are kind of **technology driven...Those are really, really expensive**, and they only sample one small location and you got to put them out there. And if they're in remote locations, you got to service and maintain. It's extremely difficult…**our strength really is in our communities that are on the water**. They live there. They're the ones that are going to be impacted. They have an interest in better understanding HABs. So that's the direction that we're going in Alaska that we've chosen to go…So anywhere there's a community, if we can promote their interest and their capacity for HABs, then that's a way of getting a nice geographic distribution of as much information as possible. (Interview 06)
>
> **I feel like that conversation [about standardization] has been going on for a long time and we're having the same conversation**…with just slightly different groups of people. And I haven't seen it advance… [what is needed is] trying to bring in the community members, the planners, the people who are going to use the data, and not just the scientists. Maybe the thing that could help this conversation ... but it's to **move it away from just being an academic conversation, to making it a practical conversation at a local scale… It seems top-down driven, rather than bottom-up.** (Interview 05)

4. Alaska Coastal Hazard CBM Collaborations

The synthesis of information about Alaska coastal hazards CBM programs identified multiple monitoring programs and external partners (Appendix C). These programs collaborate in several arenas to support CBM observations systems and use of these data in decision making (Figure 2). Given the interconnectivity among CBM programs included in the interviews, we found that mapping each type of collaboration between CBM programs would have resulted in a highly complex network. A complete network analysis to map all the relationships among CBM programs would have been outside of the scope of work. As a result, this concept map does not specifically aim to illustrate all the networks and relationships among CBM programs. Instead, the concept map aims to show how CBM programs can operate within a collaboration space where a range of activities support collection and sharing of information.

We focus the concept map on identifying collaborations and CBM data use for the CBM programs that we identified through the interviews and document analysis. The individual CBM programs are represented as the small blue circles. Fewer coastal erosion CBM programs were identified compared to HABs CBM programs, and not all the coastal erosion CBM programs had clear connections to HAB monitoring. The concept map also moves away from directional expectation for information flow to support decision making. Decision-making is seen as a collaborative activity, and CBM data can be used by people within and outside of the CBM programs. The CBM information users are therefore depicted as the people icon in the yellow circle that includes some overlap with CBM programs, but with some information users completely external to the CBM programs. Other external partnerships with CBM programs can include multiple formal and informal relationships with CBM programs. Linkages to governmental agencies can be complex. For instance, government agencies may partner with CBM programs in monitoring activities, providing lab testing support, and/or providing funding and training support. However, CBM programs are often a small part of the overall information used, or services provided by organizations such as federal and state government agencies, universities, or the general public.

Within the range of collaboration activities, we identified some activities where there were clear opportunities for standards development with CBM programs. These include data collection and protocols, and shared practices to support data sharing and data integrity. Some collaborative activities, such as providing graduate student training, may not be immediate priorities for developing standards.

Finally, we show that in the case of HABs monitoring, the Alaska HAB network provides a supporting framework for networking and information sharing across CBM programs. Within the coastal erosion CBM programs, there is also ongoing collaboration among CBM programs and other agencies and institutions, but a more formal network was not identified.

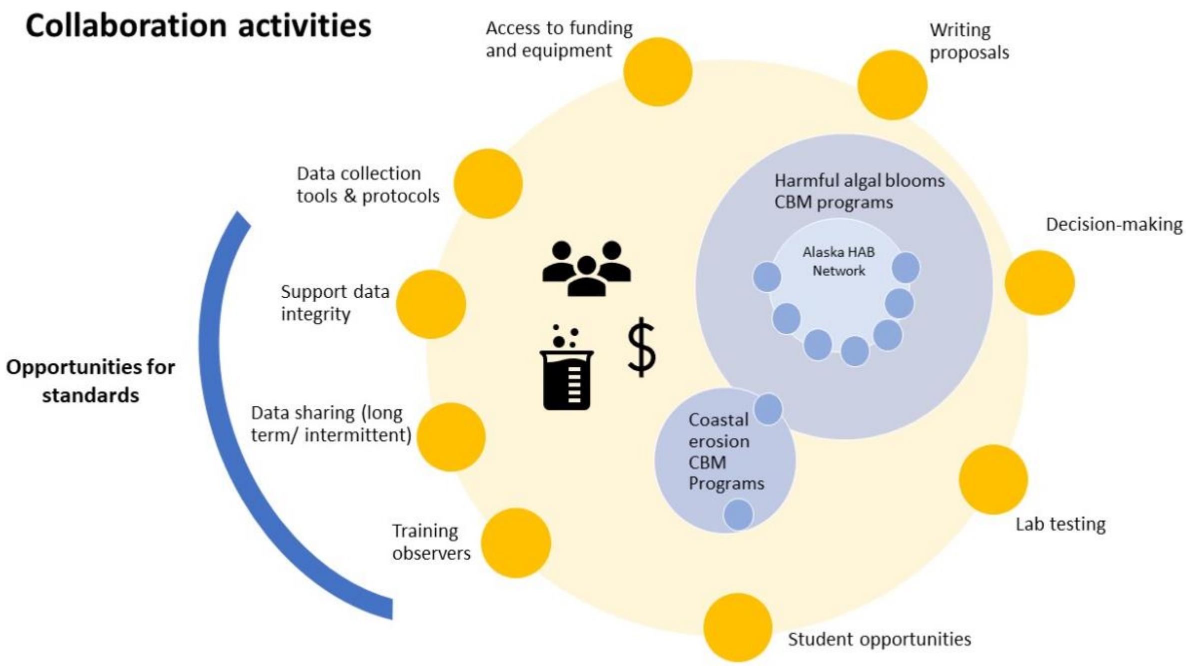

Figure 2. Concept map of networks of CBM programs relating to coastal hazards and HABs (small blue circles) and collaboration activities with opportunities for standards development. Icons representing some external partners to CBM programs are shown in the yellow circle including CBM data users, funders, and lab facilities.

Appendix A: Permafrost thaw and coastal erosion documents

AFN. 2018. Erosion and Alaska Native Communities. Alaska Federation of Natives. 20 pages.

AIJ. 2017. Climate change, displacement, and community relocation: lessons from Alaska. Alaska Institute for Justice. 20 pages.

ANTHC 2021a. Center for Environmentally Threatened Communities. Alaska Native Tribal Health Consortium. Alaska Native Tribal Health Consortium. Anchorage, AK. https://www.anthc.org/center-for-environmentally-threatened-communities/

ANTHC 2021b. Center for Environmentally Threatened Communities, Newsletter 43. Alaska Native Tribal Health Consortium. Alaska Native Tribal Health Consortium

Bronen, R. 2015. UN Special Rapporteur on the human rights of internally displaced persons. Alaska Institute for Justice. 48 pages.

Buzzard, R., J. Overbeck, C. Maio. 2019. Community-based methods for monitoring coastal erosion: Alaska Division of Geological and Geophysical Surveys Information Circular 84, 35 pages.

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Appendix C: List of identified coastal hazard and HABs monitoring programs and partners

HABs monitoring:
Applied Research in Environmental Sciences (ARIES); Alaska Sea Grant Marine Advisory Program; Alaska DEC (Department of Environmental Conservation) Environmental Health Lab; Alaska HABs network (AHAB) / Alaska Ocean Observing System (AOOS); Alutiiq Pride Marine Institute (APMI); Chugach Regional Ocean Monitoring Program (CROM); Environmental Protection Agency (EPA); National Oceanic and Atmospheric Administration (NOAA) Phytoplankton Monitoring Network; NOAA National Centers for Coastal Ocean Science (NCCOS); Norton Sound Health Corporation (NSHC); Indigenous Sentinels Network (ISN); Kachemak Bay National Estuarine Research Reserve (KBRR); Kodiak Area Native Association (KANA); Knik Tribal Council; Qawalangin Tribe of Unalaska; Southeast Alaska Tribal Ocean Research (SEATOR)

Coastal hazards monitoring:
Alaska Institute of Justice (AIJ); Applied Research in Environmental Sciences (ARIES); Alaska Arctic Observatory and Knowledge Hub (AAOKH); Alaska Division of Geological and Geophysical Surveys (DGGS); Alaska Native Tribal Health Consortium (ANTHC), Local Environmental Observer Network (LEO); Indigenous Sentinels Network (ISN); Regional tribal health organizations; Tribal staff funded by the General Assistance Program (GAP)

Coastal hazards partners:
Alaska Coastal Resilience Partnership; University of Alaska (coastal engineers, researchers); Other working groups (e.g., Alaska Water Level Watch)

Other broadly defined partners:
Universities; state and federal agencies; public; emergency response managers; co-management bodies; Tribal communities; subsistence harvesters

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Project partners:

No	Acronym	Participant Legal Name	Country
1	NERSC	STIFTELSEN NANSEN SENTER FOR MILJO OG FJERNMALING	NO
2	NORDECO	NORDISK FOND FOR MILJØ OG UDVIKLING	DK
3	Ilisimatusarfik	Ilisimatusarfik, Grønlands Universitet, University of Greenland	GL
4	AWI	Alfred-Wegener-Institut Helmholtz-Zentrum fur Polar- und Meeresforschung	DE
5	IEEE	IEEE France Section	FR
6	NINA	STIFTELSEN NORSK INSTITUTT FOR NATURFORSKNING NINA	NO
7	UCPH	KOBENHAVNS UNIVERSITET	DK
8	NIERSC	Scientific foundation Nansen International Environmental and Remote Sensing Centre	RU
9	ARC-HU	Arctic Research Centre, Hokkaido University	JP

Subcontractors

	ELOKA	Exchange for Local Observations and Knowledge of the Arctic	USA
	UAF/IARC	University of Alaska Fairbanks/ International Arctic Research Center	USA
	CSIPN	Center for Support of Indigenous Peoples of the North	Russia
	E84	Element 84	USA